

WORKSHOP ON NANOMAGNETISM USING X-RAY TECHNIQUES

Introduction to Workshop

Sam Bader
(Argonne National Laboratory)

Laura Lewis
(Brookhaven National Laboratory)

George Srajer
(Argonne National Laboratory)

Workshop Chairs



Scientific Program Advisory Committee

- ***Gabe Aeppli (London Center for Nanomaterials)***
- ***Arthur Epstein (Ohio State University)***
- ***Eric Fullerton (Hitachi Global Storage Tech)***
- ***Denis McWhan (Retired Associate Lab Director, BNL, and Member of the APS Scientific Advisory Committee)***
- ***Ivan Schuller (UCSD)***
- ***Jon Slaughter (Motorola)***
- ***Jo Stohr (Stanford University and Member of the APS Scientific Advisory Committee)***





Workshop Scope

- To understand the magnetic behavior of individual building blocks of nanomagnetic systems, which are combined into more complex structures leading to devices with new functionalities.
- Evaluate the advances in nanomagnetism that are scientifically/technologically exciting and significant.
- Areas of nanomagnetism where x-ray characterization techniques have major impact:
 - Confined Magnetism:** Layered and artificially structured systems
 - Cluster Magnetism:** Molecular magnets, spin ice and spin glasses
 - Phase Separated Systems/Complex Oxides**
- Develop the potential of x-ray polarization based techniques which are ideal to study nanomagnetism.





Grand Challenges in Nanomagnetism and Opportunities for X-ray Techniques to Address them



A Small Sampling of Scientific & Technological Challenges

Confined Magnetism: ???????

Cluster Magnetism: ?????

Phase Separated Systems/Complex Oxides: ?????

ADD MORE TOPICS AS NEEDED

*.....and We Will Identify Many More Challenges
Of Next 5-10 Years at this Workshop*



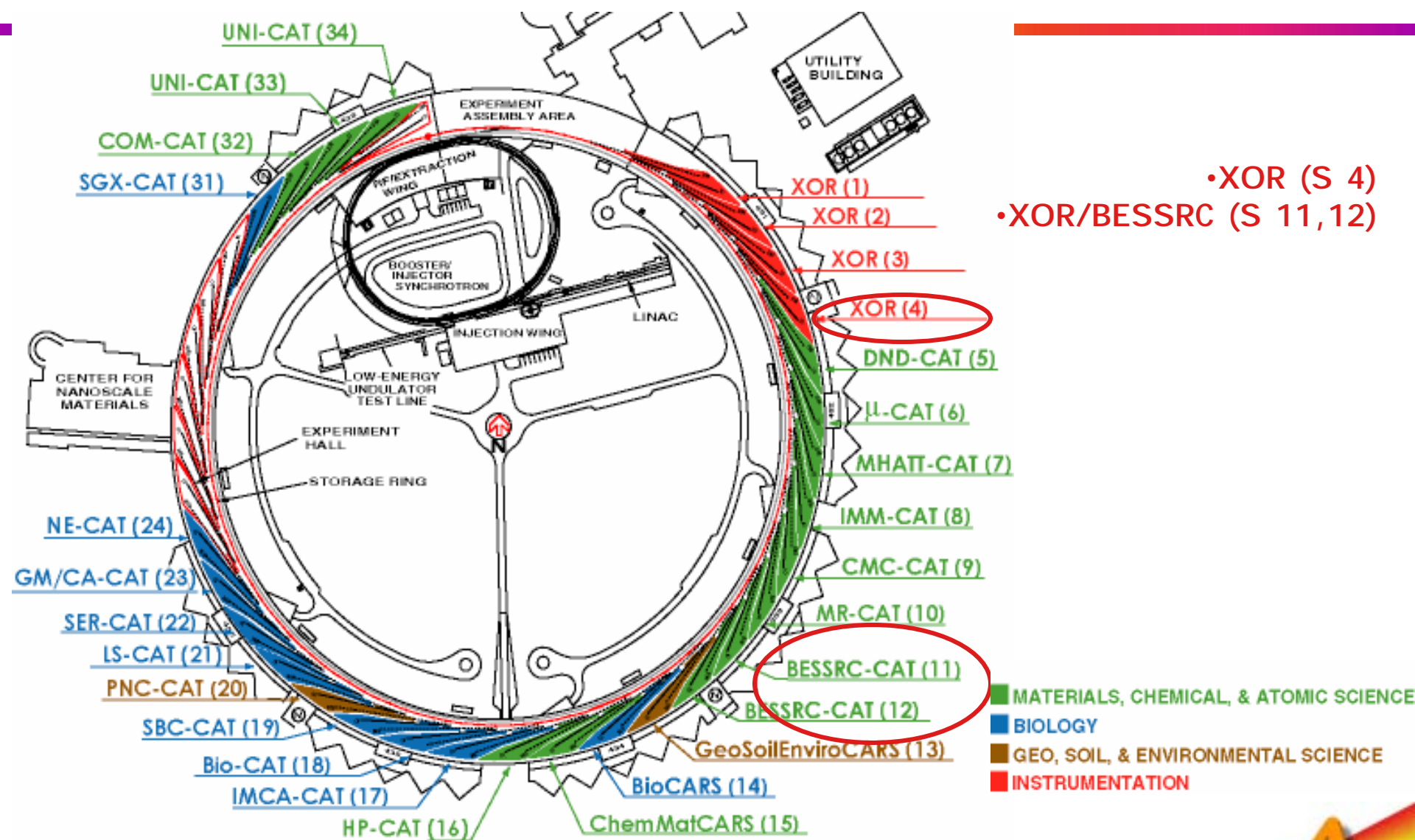


Practical Challenges

- **Higher beam brilliance with variable polarization**
 - Polarization switching
 - Photon energy ranges
 - Nanofocus capabilities
- **Techniques required to address scientific challenges?**
- **Unique experimental environments**
 - High static magnetic fields
 - Domain switching at high frequency
 - Integration of laboratory based techniques with x-ray tools
 - e.g.: MOKE
 - Need for large H/T capabilities
 - e.g., Sub-Kelvin refrigerator in large magnetic fields
 - Sub-micro sample scanning stages
- **R&D on polarized X-ray techniques, etc., etc.....**



APS Nanomagnetism Study Capabilities



- XOR (S 4)
- XOR/BESSRC (S 11,12)



Draft Workshop Objectives

1. Explore the **breadth of nanomagnetism** covered by the Workshop topics, *not* limited to synchrotron techniques alone.
2. **Identify opportunities** for continued scientific and technology discoveries and the impact using the APS during the next 5-10 years.
3. Identify **new scientific proposals/programs** specific to the emerging areas of nanomagnetism that the participants will bring to the APS during next 5 to 10 years.
 - *Evaluate the capital and operational requirements for these proposals/programs.*





Draft Workshop Objectives *(cont'd)*

4. In addition to available beamline capabilities at the APS, **identify future needs** to support research in this area of science and technology.
5. **Address R&D** in enhancing the capabilities of the APS nanomagnetism research effort.
6. Address the need and support for **theoretical work** to strengthen the experimental research.
7. Prepare a **summary document for the archival literature** to serve as a roadmap for Nanomagnetism research using x-rays at the APS Source and suggest the role of the APS towards this objective.





Charge to the Participants

1. **Identify grand challenge science and technological problems in nanomagnetism** that should be addressed during next 5-10 years using x-ray techniques at a third-generation synchrotron radiation source.
2. **Identify and justify the technical requirements** to meet the grand challenge problems:
 - New instrumentation and techniques that need be developed on existing beamlines to perform new kind of science;
 - Need for new dedicated beamlines and instrumentations for this community.
3. **Identify both short- and long-term R&D** needs in areas such as x-ray techniques, sample environment, optics & data analysis to prepare the community to address these grand challenges.





Workshop Report

- Summaries and slides provided by the speakers of the talks can be accessed directly by clicking the 'summary' or 'slides' in the 'program' on the workshop website.

<http://www.future.aps.anl.gov/Future/Workshops/Nanomagnetism/program.htm>

- You can continually input your thoughts using the 'Swiki' software linked to lap-top computers using Wi-Fi. (Input can be made even after the workshop).
 - <http://swiki.anlgh.org/Nanomag>
 - Login Name: nanomag
 - Password: spin
- Address previous objectives in each of the topics in the scope of the Workshop after each talk and make recommendations to the APS.



APS Strategic Planning Meeting

"Future Scientific Directions" September 2 & 3, Fontana, Wisconsin
www.future.aps.anl.gov/Future/Strategic_Planning_Meeting/home.htm

	Thursday Sept. 2, 2004	Friday, Sept. 3, 2004
8:00 am	Introduction & Charge	
8:30 am	Report on Time Domain Workshop	Report on Nanomagnetism Workshop
9:30 am	Report on Inelastic Scattering Workshop	Report on Big Magnet
10:00 am	<i>Break</i>	<i>Break</i>
10:30 am	Report on Imaging Techniques Workshop	Report on High-Energy X-rays Workshop
11:30 am	Report on Meso/Nanoscope Workshop	Report on Biological Crystallography Workshop
12:30 pm	<i>Lunch Break</i>	<i>Lunch Break</i>
2:00 pm	Report on Membrane Science Workshop	Discussion and Wrap-Up
3:00 pm	Report on BES-Funded Sectors Science	
3:30 pm	<i>Break</i>	
4:00 pm	Report on Environmental Workshop	
5:00 pm	Report on Soft X-rays Workshop	Adjourn
6:30 pm	Dinner	



Nanomagnetic Workshop schedule

<p><i>Sunday, August 29</i> Reception/dinner Introduction and Charge to Participants: Synchrotron Investigations into Grand Challenges of Nanomagnetism: S. D. Bader</p> <ul style="list-style-type: none"> ▪ Where have we been? ▪ Where are we going? ▪ How will we get there? 		
<p><i>Monday, August 30</i> 0800: Introduction and repeat of Charge to Participants: L. H. Lewis Plenary Session I: Gabriel Aeppli, Chair</p>		
<p>1000 – 1030: Break</p>		
<p>Breakout Session A1: 1030 – 1230: Ivan Schuller, Chair <i>Confined magnetism</i></p>	<p>Breakout Session A2: 1030 – 1230: Art Epstein, Chair <i>Cluster Magnetism</i></p>	<p>Breakout Session A3: 1030 – 1230 L. H. Lewis, Chair <i>Phase Separated Systems/Complex Oxides</i></p>
<p>Lunch and free time 1230- 1600</p>		
<p>1600: Theme Discussion Leaders present preliminary summary of emerging ideas</p>		
<p>Plenary Session II: Jon Slaughter, Chair</p>		
<p>Dinner 2000 – 2030: Overview of synchrotron techniques for nanomagnetism studies: J. Lang 2030 – 2100: Wrap up</p>		



Nanomagnetic Workshop schedule (cont'd)

Tuesday, August 31

0830: Plenary Session III Denis McWhan, Chair

1000 – 1030: Break

Breakout Session B1: 1030 – 1230 Eric Fullerton, Chair <i>Confined magnetism</i>	Breakout Session B2: 1030 – 1230 Myriam Sarachik, Chair <i>Cluster Magnetism</i>	Breakout Session B3: 1030 – 1230 Myron Salamon, Chair <i>Phase Separated Systems/Complex Oxides</i>
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Lunch and free time 1230 - 1600

1600: Theme Discussion Leaders present preliminary summary of emerging ideas

Plenary Session IV Caroline Ross, Chair

1830: Dinner

2000 – 2100: Wrap up

Wednesday, Sept. 1

0900 - 1030: Representatives provide overall summary to all Workshop attendees for final input, refinement: Bader, Lewis, Srajer

1000 – 1030: Break

10:30 - 12:00: Individual groups compile report sections.

12:00 - 1:00 Lunch; continuation of report preparation

Room	Sunday, August 29		Monday, August 30		Tuesday, August 31		Wednesday, Sept. 1	
	AM	PM	AM	PM	AM	PM	AM	PM
Aspen		X	I, A-1	II	III, B-1	IV	V	
Geneva I			A-2		B-2			
Geneva II			A-3		B-3			

